

STORAGE CHARACTERISTICS OF APPLE AND GRAPE JUICE FULL-FLAVOR SUPERCONCENTRATES

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INTRODUCTION

A process for preparing 7-fold apple juice concentrate with restored essence was published in 1951 (3)². A public preference for juice reconstituted from this concentrate over single-strength bottled juice has been demonstrated (1). A modification of the apple concentrate process was adapted to Concord grape juice (2). Refrigerated storage was recommended for both of these products since, in order to avoid jeopardizing their characteristic fresh flavor, they were not hot packed in the conventional way. Moreover, in the absence of storage tests there was reason to question the shelf life of products wherein the potential reactants in the Maillard reaction were highly concentrated. The Western Utilization Research Branch has conducted room temperature storage tests on hot-packed 4-fold concentrates (5).

Results of storage tests on superconcentrates conducted at several temperatures and with various preservatives are described here. These demonstrated that 7-fold full-flavor concentrates made from apple or grape juice can be stored satisfactorily at 73° F. for upwards of a year if hot packed in the conventional way without preservatives in glass or in double-coated side-seam striped tin cans.

APPLE JUICE CONCENTRATE

Preparation

The juice used in preparing the concentrates was a blend of two parts Jonathan, one part McIntosh, one part Stayman-Winesap, and one part Northern Spy. Essence was stripped in the usual way, the stripped juice was then depectinized overnight, and the enzymes were inactivated by heating for 2 seconds at 210° F.; the juice was filtered, and concentrated under 26½" vacuum to 71° Brix, and the essence was then restored to the concentrate. All was done substantially according to the process described in (3). Storage tests were made at 35° F., 73° F., and 100° F. in 4-ounce glass bottles and 4-ounce double-coated side-seam striped cans. In the series were the following samples: (1) 0.1% sodium benzoate added, (2) sulfur dioxide added, (3) hot packed in the conventional way, and (4) hot packed with ascorbic acid. Sodium benzoate was added in the absence of any heat treatment to prevent biological changes. Sulfur dioxide was used at concentrations of 200 and 300 ppm; concentrations

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² UNDERLINED NUMBERS IN PARENTHESES REFER TO LITERATURE CITED, PAGE 5.

near the low limit commonly accepted as preventing biological spoilage but sufficient to influence chemical changes. Because of the tendency of SO_2 to destroy the characteristic apple flavor, it was added to the concentrate in the absence of essence, the latter being restored at the time of tasting. Ascorbic acid was used to minimize oxidative changes and was added to the extent of 440 mg/100 g., corresponding to 80 mg/100 g. in the reconstituted juice.

In the hot-packed samples the concentrate was brought to 180°F . in about 145 seconds in a Votator³ and then filled into the 4-ounce can or bottle in 45 seconds. The containers were closed and inverted and then cooled by immersion in cold water. The cover was in contact with the hot concentrate for about 30 seconds before cooling. The contents reached room temperature in about 15 minutes. The overall heat treatment incident to hot packing was equivalent to about $2\frac{1}{2}$ minutes at 180°F . This approximates the heat effect obtainable in commercial filling and closing machines. The hot-packing conditions chosen are less drastic than those which might be considered necessary for single-strength fruit juices. In order to preserve the "fresh fruit" flavor which characterizes this product, advantage was taken of its high degree of resistance to microbiological spoilage. Because of the very high sugar content and high acidity, the only organisms that could probably grow in the absence of air are the relatively rare acid-resistant osmophilic yeasts. It has been common practice in the industry to pack high-density fruit juice concentrates in bulk without any heat treatment whatever. Thus, the heat treatment used here constitutes a margin of safety.

Using the same blend of apples as above, we prepared a concentrate which also included the juice obtained by the leach pressing of the pomace (4). By adding an equal quantity of water to the first press pomace, followed by a second pressing, 16% more concentrate was obtained from the same weight of apples. The juices from the two pressings were combined, and a full-flavor concentrate was prepared in the same manner as described above. The storage characteristics of the leach press concentrate were compared to those of a conventional concentrate at 35°F .

In order to observe the effect of diluting the ingredients which might participate in the Maillard reaction, samples were also prepared to which sucrose was added in an amount equal to the apple solids. The original Brix:acid ratio was then restored by adding citric acid. Full-flavor was contributed by adding essence equivalent to the added sucrose; thus the ratio of aroma to total solids remained the same as in the original juice. It is interesting to note that the flavor of the juice reconstituted from this product was excellent and was preferred to natural apple juice by several members of the taste panel.

The samples were reconstituted to juice strength and periodically tasted by a trained taste panel. Individuals were chosen for their knowledge of apple juice and for their consistency and acuity in tasting as measured by their ability to detect identical samples in a series of unknowns and the proximity of their rating to the panel average. Samples were rated on a scale of 1 to 10, 8 being the standard (full-flavor concentrate, no additive, no heat treatment) and 6 the "limit of acceptability." It is recognized that even a large panel, however skilled, cannot dependably predict the market acceptability of a product. The term acceptable used here means that the reconstituted product still possesses the characteristic flavor of the fruit and does not possess to any marked degree flavors foreign to a juice reconstituted from a freshly prepared full-flavor concentrate.

³ MENTION OF A SPECIFIC PRODUCT DOES NOT IMPLY RECOMMENDATION OR ENDORSEMENT BY THE U. S. DEPARTMENT OF AGRICULTURE OVER SIMILAR PRODUCTS NOT MENTIONED.

valuation

All of the samples stored at 100° F. suffered rapid flavor damage and all were very poor in flavor after 2 months--with one exception. The exception was concentrate containing 300 parts per million of SO₂ to which essence was not restored until just before tasting. The sulfur dioxide destroys the delicate apple flavor so rapidly that the juice must be consumed shortly after adding the essence if the apple flavor is to be enjoyed. However, the product reconstituted in this way, although of very good flavor, would be of no commercial value because a marked darkening developed after 4 months.

At 73° F. the best samples were those hot packed. The hot packing itself reduced the rating from 8 to 7.5 before the storage period began. However, the rate of change thereafter was so slow that after one year the reconstituted samples were still of good quality and rated 6.8 and 6.7, respectively, for the canned samples and the bottled samples⁴. This slight difference between the ratings for the different packages is of no significance. An almost identical storage life was manifest in the samples to which sugar, acid, and essence had been added.

All of the samples stored at 35° F. possessed good flavor attributes after one year's storage.

Concentrate prepared by the leach press technique stored as well at 35° F. as the conventional concentrate.

GRAPE JUICE CONCENTRATE

Preparation

The grape juice concentrate was made from juice produced commercially without depectinization from New York State Concorde. It was prepared as described in (2), i.e., by vaporizing 30% of the juice to strip the essence, depectinizing overnight, clarifying by filtration, inactivating the pectinase, concentrating under 27" vacuum to 74.9° Brix, adding a sucrose solution of the same Brix to obtain sugar solids equal to 50% of the natural grape solids and then restoring the essence.

The samples were prepared by (1) adding 0.1% of sodium benzoate, (2) adding 0.1% sodium benzoate, plus 4.4 milligrams per gram of ascorbic acid, (3) hot packed (under the conditions used for apple juice concentrate), and (4) hot packed with 4.4 milligrams per gram of ascorbic acid. Storage was at 73° F. and 100° F. in 4-ounce bottles and 4-ounce double-coated side-seam striped cans. The standards for rating and selection of the taste panel were as described for apple juice concentrate.

Evaluation

Grape juice concentrates were evaluated in the same manner as apple juice concentrates. At 100° F. all the samples deteriorated rapidly, and were very poor after only about 2 months. At 73° F. the samples containing sodium benzoate with and without ascorbic acid were poor after about 6 months. In contrast, the hot-packed sample without any additive had dropped only to 7.3 after a year's storage. The difference of 0.7 between the standard 8 sample (full-flavor concentrate, no additive, no heat treatment)

STATISTICAL ANALYSIS OF THE TASTE-PANEL RESULTS SHOW THAT THE DIFFERENCES BETWEEN 8 AND 7.5 AND BETWEEN 7.5 AND 6.8 ARE SIGNIFICANT (P = 0.05). HOWEVER, THE DIFFERENCE BETWEEN THE FINAL RATING 6.8 AND THE "LIMIT OF ACCEPTABILITY" (6) IS ALSO SIGNIFICANT (P = 0.05).

and the year-old sample is significant ($P = 0.05$). However, reconstituted juice from the latter sample was still very palatable. In one series of tests the hot-packing step reduced the rating from 8 to 7.2 with no significant change thereafter. In another series, using a juice with a different history of manufacture, the hot packing produced no change. But after the year's storage, the samples from both series had almost identical flavor ratings. Keeping properties were equally good in glass and cans. The samples similarly packed but with ascorbic acid were still acceptable after a year but remained definitely poorer, after the lapse of 6 months, than the sample without ascorbic acid.

CONCLUSIONS

Full-flavor 7-fold concentrated apple and grape juices prepared by procedures developed at the Eastern Utilization Research Branch of the Agricultural Research Service can be safely stored for a year or more at room temperature if hot packed in glass or in double-coated side-seam striped cans. Thus the advantages of concentration may be enjoyed without the necessity of freezing or refrigeration and their attendant hazards of inadvertent thawing or warming.

No practical way of preparing concentrates for prolonged storage at 100° F. has been found. Shelf life at this temperature is at most 2 months.

Concentrate prepared by the leach press technique stores as well at 35° F. as the conventional concentrate.

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